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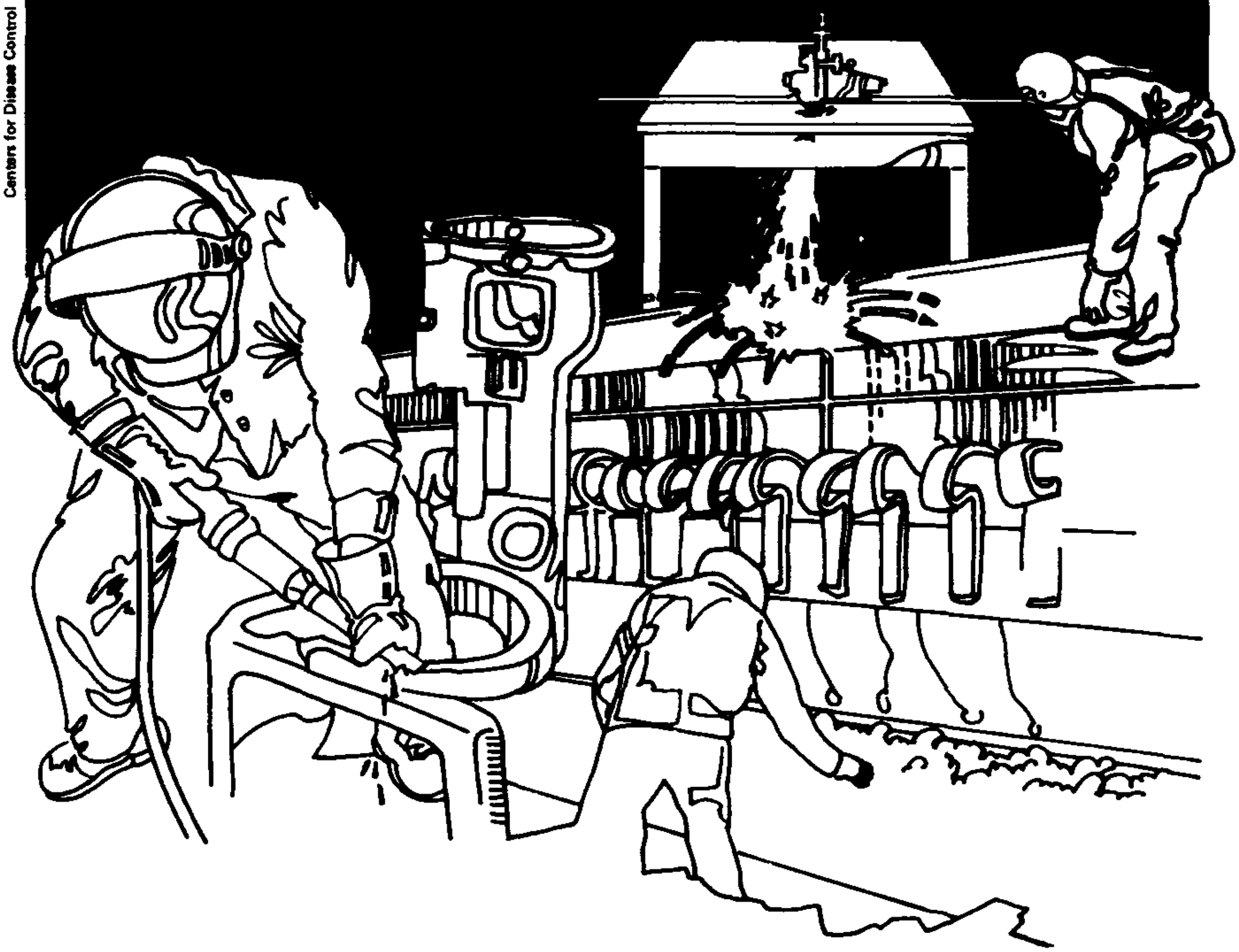

Health Hazard Evaluation Report

HETA 89-262-1994
CHAPMAN CORPORATION
ALBRIGHT POWER STATION
ALBRIGHT, WEST VIRGINIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 89-262-1994
NOVEMBER 1989
CHAPMAN CORPORATION
ALBRIGHT POWER STATION
ALBRIGHT, WEST VIRGINIA

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I. SUMMARY

On May 31, 1989, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Brotherhood of Electrical Workers (IBEW), Local 425, to evaluate electrical workers' exposures to asbestos in the work areas outside of the asbestos containment area (boiler #3), at the Albright Power Station in Albright, West Virginia. On June 6, 1989, asbestos air sampling was conducted at the power station. Eleven air samples (eight personal breathing-zone and three area) were collected and analyzed by phase contrast microscopy (PCM) for fibers according to NIOSH Method 7400, using the "A" counting rules. Four of these samples were further analyzed by transmission electron microscopy (TEM), also using the "A" counting rules.

Asbestos concentrations on the personal samples ranged from 0.006 fibers/cc to 0.037 fibers/cc. Area concentrations ranged from 0.011 to 0.103 fibers/cc, and the highest concentration (0.103 fibers/cc), was an area sample collected at the exhaust outlet of a negative pressure air unit. All eleven air samples had fiber concentrations greater than what was detected in the ambient outdoor air (0.003 fibers/cc, the limit of detection (LOD)). Four of eleven air samples were analyzed by TEM. Results indicated 9% to 75% of the fibers detected were asbestos fibers. The Occupational Safety and Health Administration's (OSHA) standard for occupational exposure to asbestos is 0.2 fibers/cc (analysis by PCM).

The NIOSH air sampling results indicate that asbestos fiber releases have occurred outside the containment area. In addition, bulk samples of settled dust, collected by Albright management, Chapman Corporation, and an IBEW representative, after the containment enclosure had been removed, revealed asbestos contamination in the work areas surrounding boiler #3. During the NIOSH survey several deficiencies in the asbestos removal program were noted including the lack of adequate containment, and breaches in the enclosure. NIOSH recommends that occupational exposure to asbestos be controlled to the lowest feasible level. NIOSH contends there is no safe level of exposure to asbestos. If detectable levels of asbestos are found, further evaluation of the work environment is warranted and recommendations to reduce exposures to asbestos need to be implemented.

Asbestos fibers were detected in air samples collected at the Albright Power Station, outside the asbestos containment area. Employees who worked in the vicinity of boiler #3, had potential exposures to airborne asbestos fibers at concentrations greater than ambient. Recommendations are made to help management representatives minimize potential occupational health risks through the establishment of comprehensive asbestos abatement programs and policies.

KEYWORDS: SIC 1731 (Electrical Work), 1542 (General Contractors), 4911 (Electric Services), 9999 (not otherwise classified), asbestos, chrysotile, electricians, electrical, power plant

II. INTRODUCTION

On May 31, 1989, NIOSH received a request from the International Brotherhood of Electrical Workers, Local 425, to evaluate electrical workers' exposures to asbestos in the work areas surrounding the asbestos containment area (boiler #3), at the Albright Power Station in Albright, West Virginia. On June 5, 1989, at the Albright Power Station, investigators from NIOSH met with the on-site Superintendent of the Chapman Corporation, and an authorized representative of the Electrical Workers Union, for an opening conference to discuss NIOSH's Health Hazard Evaluation (HHE) procedures and background events, and to present the sampling protocol and survey strategies. A walk-through inspection was conducted the same day to review general work processes and operations conducted by the electrical workers. Eleven full-shift air samples (eight personal breathing-zone and 3 area) were collected on June 6, 1989, to determine airborne asbestos levels. This report will discuss the evaluations and results from the asbestos sampling. On August 31, 1989, a summary of the asbestos sampling results was verbally reported to plant management officials and the Chapman Corporation.

III. BACKGROUND

The Albright Power Station is located on 42 acres in Albright, West Virginia. This coal-fired electric-power generating plant was built in the early 1950's. Electricity is produced at the plant from two steam-powered turbine generators. Steam is generated from three coal-fired boilers (boiler #3 generates 150 megawatts of power, and boilers #1 and #2 generate 75 megawatts each).

At the time of this NIOSH survey, a complete refurbishing of boiler #3, which had begun several months prior, was underway. Part of this job included an asbestos abatement project. Chempower Incorporated, was contracted by the Monongahela Power Company (part of the Allegheny Power System), owners of the plant, to remove and dispose of asbestos containing materials (ACM) (i.e. approximately 40,000 square feet of insulation) behind the boiler plate (outside casing) of boiler #3, and nearly 12,000 linear feet of pipe covering at the Albright Power Station. A schematic drawing of the five and one-half story boiler is included as Appendix I. During the abatement job, the entire boiler was enclosed in plastic sheeting as is typical of most asbestos removal projects.

The Monongahela Power Company contracted with the Chapman Corporation to perform electrical rewiring tasks on boiler #3. Electricians employed by Chapman did not work inside the asbestos containment area during this NIOSH survey. However, they did perform work outside and around the asbestos containment area, removing old wiring and installing new electrical wires at several locations surrounding boiler #3, connecting existing wiring to new wires at the instrument control boxes, and removing and replacing existing conduit/tubing with new materials. When the Chapman Corporation began work at the Albright Power Station in January 1989, 22 journeymen electricians and 2 apprentice electricians were hired for the job. At the time of the NIOSH survey, there were 15 journeymen electricians, 1 apprentice, and 3 pipefitters employed by Chapman at Albright.

In view of the carcinogenic potential of inhaled asbestos fibers, it is important to identify its presence (or confirm its absence), and evaluate the potential hazards of exposures to asbestos released from controllable sources. This NIOSH health hazard evaluation, although limited in scope, was designed to characterize the Chapman Corporation electricians' exposures to asbestos at the Albright Power Station and to make recommendations to further reduce asbestos exposures at the plant.

Asbestos fiber release resulting in potential exposure episodes may occur whenever maintenance or repair work requires the removal, drilling, or cutting of ACM. At this plant, asbestos fibers could be distributed by: a) breaches of the asbestos containment area (rips/tears and holes in the plastic walls), b) some areas inside the containment enclosure being under positive pressure with respect to the outside, c) personnel leaving the containment area without showering and/or changing protective clothing (decontamination), d) negative pressure air units with overloaded filters which may allow asbestos fibers to exhaust from the containment area and, e) equipment and/or materials which are brought out of the containment area without undergoing asbestos decontamination procedures. Another potential source of asbestos fiber exposures is the existing electrical wires/cables which were insulated with ACM. Some of the rewiring jobs were performed after the NIOSH survey was completed and reportedly were done inside enclosures (glove boxes) while workers were wearing respirators.

IV. EVALUATION DESIGN

There are currently a variety of methods available for asbestos analysis. The most widely used methods are: phase contrast microscopy, polarized light/dispersion staining microscopy, scanning electron microscopy, and transmission electron microscopy. Each of these methods can have many variations. Methods for sample collection, transportation, and preparation of samples for analysis are also important. It would not be practical to discuss in detail all of these sampling and analytical techniques, their many variations, and their relative merit. Most of this information can be found in numerous references; however, a discussion of some of the important issues of these sampling and analytical methods is presented below.

1. Phase Contrast Microscopy Analysis (PCM)

NIOSH investigators use methods in the NIOSH Analytical Methods Manual for the quantification of asbestos exposures.[1] This method involves phase contrast microscopy (PCM) techniques, with electron microscopy used as a confirmatory method where a problem of fiber specificity exists.

Phase contrast microscopy is the most widely used method for asbestos analysis. This method was developed as a practical and economical way to determine an index of "true" asbestos exposures using existing technology. This method works adequately in occupational settings and most existing asbestos recommendations and standards reference this method. The NIOSH PCM method 7400[1], as with all PCM techniques, cannot identify fiber types, because the wavelength of visible light limits the analytical resolution. A fiber is defined as being greater than or equal to 5 microns (um) in length, with a length three times greater than the apparent diameter (aspect ratio). The 5um length criterion was selected because fibers of this length could easily be seen by trained microscopists using available PCMs. This length criterion was not selected due to an abundance of toxicological data implicating only fibers of that size or larger as hazardous, but because of the PCM limitations of resolution and the need to have standardized counting rules. The PCM results may contain other fibers than asbestos such as cellulose, fibrous glass, mineral wool, etc. This is why exposure concentrations derived from using this criterion provide an index of asbestos exposure (not a solely asbestos fiber exposure) with an acceptable level of analytical precision. The cost of laboratory analysis using PCM techniques generally ranges from $30.00 to $40.00 per sample.

The PCM method has become an internationally accepted analytical technique for measuring airborne asbestos fibers and, except for Germany and the USSR, all of the occupational exposure standards and recommended criteria for airborne asbestos have been developed in units that can be evaluated by using the PCM method; usually expressed as fibers greater than 5um (>5um) in length per cubic centimeter (cc) or per milliliter (ml) of air. Therefore, there are currently no occupational asbestos standards that are referenced to total fiber exposures which address small fiber (<5 um) exposures.

In an effort to establish dose-response relationships, the majority of epidemiological studies of workers exposed to asbestos have correlated the incidence of asbestos-related disease with airborne fiber exposures as determined by the PCM method. Workers were actually exposed to asbestos fibers of all sizes (total fibers), and the resulting health risk has been correlated only with this exposure index (fibers >5um in length). Thus, essentially all asbestos-related health effects are compared to the airborne asbestos exposure standards. Determination of the relative toxicity of different length asbestos fibers for humans would be impossible from this epidemiological data, due to the lack of exposure data specifying different fiber sizes or distributions of fibers of varying length.

Since human epidemiological data cannot be used to determine the toxicity of small fibers, animal studies have been conducted. Animal research suggests that long (>5um) asbestos fibers are the most tumorigenic with short (<2.5um) fibers having little tumorigenic effect. These studies, however, are not conclusive and it is not known which asbestos fiber sizes are biologically active for production of the various asbestos-related diseases.

2. Bulk/Surface Samples

When fiber identification is required, other analytical methods must be employed. Polarized light microscopy (PLM) and dispersion staining (DS) techniques are commonly used to analyze bulk materials for the presence of asbestos. In fact, PLM is the Environmental Protection Agency's (EPA) recommended procedure for analyzing potential asbestos-containing materials in schools. The use of PLM with DS techniques to identify asbestos on air samples is of limited utility since only fibers of relatively large diameters ($\geq$1um) can be readily identified in this manner. Environmental air monitoring is used to characterize current exposure conditions, while settled dust bulk samples are preferred for determining if airborne asbestos fibers have been released in the past, and what percentage of the settled material is asbestos. The percent asbestos is determined and reported as a percent area observed in the microscope field. By convention, this percent is not converted into percent mass because of the uncertainties in densities and shapes of the particles and fibers. In addition, PLM can be used to identify the specific type of asbestos. The two most common types of asbestos utilized in the U.S. are amosite and chrysotile.

Settled dust samples can be obtained in several ways. One method involves scraping a small quantity of settled dust into a container and sending the sample to a laboratory for analysis by PLM. The second approach is to utilize a sampling pump, with a 25 mm filter in line, as a vacuum cleaner, for sweeping an area until the filter has noticeably changed in color. The cost of laboratory analysis using PLM techniques generally ranges from $40.00 to $60.00 for routine samples, however, depending on the type of material to be analyzed, the cost can reach $200.00.

3. Transmission Electron Microscopy (TEM)

Scanning electron microscopy (SEM) and transmission electron microscopy (TEM), are two other methods that are increasingly used for the analysis of asbestos samples. SEM is quicker and cheaper, but TEM provides superior microscope resolution and fiber identification. By observing fiber morphology and using energy dispersive X-ray analysis (EDXA), an SEM can be used to identify fibers in situations where the asbestos type is known. TEM is generally regarded as the state-of-the-art technique and can be used for fiber identification via morphology, EDXA, and selected area electron diffraction (SAED). The TEM method is somewhat slow and expensive. TEM analysis usually ranges from $200.00 to $400.00 per sample. However, it can provide more information than any of the other asbestos analytical techniques.

4. Static and Dynamic Sampling

Two broad categories of asbestos air sampling techniques are used. Static sampling is conducted without intentionally disturbing the asbestos containing materials or the surrounding air. Dynamic sampling (also called aggressive sampling) is conducted by deliberately disturbing the surrounding air to stir up any settled dust and create an environment which maximizes the airborne asbestos fiber concentrations. The results obtained with static techniques are typically lower than those obtained with dynamic techniques. The assessment of post-abatement conditions (project closeout or pre-occupancy) should always include aggressive sampling techniques.[2]

5. Air Samples

In this investigation, there was a concern that asbestos fibers may have been released during the abatement project, and dispersed into the work areas outside the containment area. In addition, workers were concerned about the potential long-term health effects from acute asbestos exposures. In response to the request for an hazard evaluation, personal breathing-zone and stationary area air samples were collected on June 6, 1989 to measure the electrical workers' potential exposures to airborne asbestos. The personal samples were attached to the workers lapel in the breathing-zone (BZ). The area air samples were placed in a stationary location at a height approximating the breathing-zone. All samples were collected using Nucleopore®, 25 millimeter (mm), 0.8 um pore size, mixed cellulose ester filters (open face) and battery-powered sampling pumps calibrated to operate at a nominal flow rate of 2.0 liters per minute (lpm). Sample volumes ranged from 838 to 940 liters.

All of the air samples were quantitatively analyzed for fibers by PCM according to NIOSH Method 7400.[1] Fibers greater than 5 um in length were counted on each sample at a magnification of 400X. The "A" counting rules were utilized. The sample results were reported in total fibers per filter. The limits of detection (LOD) and quantitation (LOQ) for this method depend on sample volume and quantity of interferring dust. Generally, the longer the sampling time, the higher the sampling flow rate, the higher the microscope resolution, and the more microscope fields counted, the lower will be the corresponding detection limit. For this sampling and analytical method, the LOD has been determined to be

<0.01 fibers/cc, for atmospheres free of interferences, using a 1000 liter air sample. The quantitative working range for the analysis of fibers via PCM (>5um in length) is 0.04 to 0.5 fibers/cc for a 1000 liter air sample (approx. 2.5 lpm for about 7 hours).

Based upon PCM fiber counts and filter loading, four of the total 11 samples were selected to be analyzed by TEM, using an energy dispersive x-ray analyzer (EDXA) and selected area electron diffraction (SAED). The samples were prepared according to NIOSH Method #7402 and analyzed on a Philips 420 STEM[3]. All counting and sizing were conducted at 10 and 500X magnification. The LOD for this method is 1 fiber per filter.

6. Bulk Analysis

Bulk analysis for asbestos is used to determine the presence of asbestos in suspected materials. Typically, bulk samples for asbestos analysis consist of various insulating materials, settled dust, and other pertinent materials.

Prior to the NIOSH survey, management representatives from the Chapman Corporation had four bulk samples of existing insulated cables/wires, which were to be reused in the boiler #3 rewiring jobs, analyzed for asbestos content by an independent laboratory.

After the NIOSH survey had been completed, and after the containment enclosure had been removed, management representatives of the Albright Power Station collected several bulk samples from work areas surrounding boiler #3, and had these samples analyzed for asbestos content. After the containment enclosure had been removed, a representative of one of the unions at Albright collected several bulk settled dust samples and short-term bulk settled dust air samples from areas surrounding boiler #3 and submitted these samples for analysis.

The technique used to analyze the bulk samples was polarized light microscopy (PLM). The PLM technique involves placing the sample material in a liquid of known refractive index on a microscope slide. The material is then observed in a polarizing microscope (e.g. Leitz Dialux 20 at 160X) with dispersion staining optics. This causes asbestos materials to exhibit characteristic colors and other optical properties. The percentage of asbestos by area observed is determined and reported.

V. EVALUATION CRITERIA

A. Environmental Criterion

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommended exposure limits (RELs), 2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH RELs and ACGIH TLVs are lower than the corresponding OSHA standards. Both NIOSH RELs and ACGIH TLVs usually are based on more recent information than are the OSHA permissible exposure limits (PELs). The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8 to 10-hour workday. Some substances have recommended short-term exposure limits (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

B. Asbestos Exposure and Health Risk

Increased health risk resulting from occupational exposure to asbestos has been well documented in the scientific literature. Initially, asbestos was associated with a chronic and debilitating lung disease called asbestosis which normally occurred following long-term exposures to high levels of asbestos fibers. Epidemiologic studies show that there is a correlation between the intensity and duration of asbestos exposure and an observed excess in several types of cancer, including mesothelioma (a rare cancer of the chest and abdominal lining) and cancers of the lung, esophagus, stomach, and colon. These cancers usually appear many years after the initial contact with asbestos, and sometimes result from short-term and/or low level exposures. NIOSH believes there is no "safe" level of exposure to asbestos for the elimination of all associated cancer risk. Thus, any exposure results in some increased health risk.

Reliable population-based studies on the increased risk of asbestos-associated diseases (pulmonary fibrosis, pleural thickening and asbestosis, lung cancer, and pleural or peritoneal mesothelioma) have been reported for certain groups with well-documented occupational exposures. The risk for both types of asbestos-associated malignancies, lung cancer and pleural or peritoneal mesothelioma, varies in a fashion consistent with a linear (non-threshold) dose-response relationship. The risk for developing lung cancer greatly increases for cigarette smokers occupationally exposed to asbestos at either high or low levels. Cigarette smoking does not appear to increase the risk for mesothelioma in exposed individuals.[4-10]

No reliable population-based data are available on which to base a direct quantitative assessment of the risk of asbestos-associated cancer due to take-home or other nonindustrial exposures to asbestos. However, indirect risk assessments have indicated that an excess risk does exist.[5,6,10] A persons age at first exposure to asbestos is an important determinant of risk of mesothelioma. Although it has not been proven that there is a linear, non-threshold dose-response relationship after nonindustrial exposures, it is thought that such a relationship does exist, that exposure to respirable-size asbestos fibers poses a carcinogenic risk for humans, that exposure beginning early in life increases the risk for mesothelioma, and that no safe level of exposure to a carcinogenic agent has been demonstrated; therefore, sources of asbestos that are likely to result in hazardous exposures should be identified and controlled.[4-10]

The cancer health risk resulting from exposure to low concentrations of asbestos is difficult, if not impossible, to quantify. The National Academy of Sciences issued a publication, "Asbestiform Fibers: Nonoccupational Health Risks", in which a risk analysis was performed to determine estimates of risk from indoor exposures to asbestos (including chrysotile). One estimate predicted an excess lifetime risk of 64 per million ($64/10^6$) for lung cancer in male smokers exposed to a median asbestos concentration (24-hour average of 0.0004 fibers/cc) and $320/10^6$ for a high asbestos concentration (24-hour average of 0.002 fibers/cc). Mesothelioma risks estimates for all worker groups were $9/10^6$ for median asbestos exposures and $46/10^6$ for high asbestos exposures.

C. Toxicologic Effects of Exposure to Asbestos

Clinical evidence of the adverse effects associated with exposure to asbestos is present in the form of several well-conducted epidemiological studies of occupationally exposed workers, family contacts of workers, and persons living near asbestos mines. These studies have shown a definite association between exposure to asbestos and an increased incidence of lung cancer, pleural and peritoneal mesothelioma, gastrointestinal cancer, and asbestosis.

Asbestosis is a disabling fibrotic lung disease that is caused only by exposure to asbestos. Exposure to asbestos has also been associated with an increased incidence of esophageal, kidney, laryngeal, pharyngeal, and bucal cavity cancers. As with other known chronic occupational diseases, disease associated with asbestos generally appears about 20 years following the first occurrence of exposure. There are no known acute effects associated with exposure to asbestos.

The signs and symptoms of lung cancer or gastrointestinal cancer induced by exposure to asbestos are not unique, except that a chest X-ray of an exposed patient with lung cancer may show pleural plaques, pleural calcification, or pleural fibrosis. Asbestos exposure acts synergistically with cigarette smoking to multiply the risk of developing lung cancer. Symptoms characteristic of mesothelioma include shortness of breath, pain in the walls of the chest, or abdominal pain. Mesothelioma has a much longer latency period compared to lung cancer (40 years versus 15-20 years), and mesothelioma is therefore more likely to be found among workers who were first exposed to asbestos at an early age. Mesothelioma is always fatal.

D. Airborne Exposure Criteria for Asbestos

NIOSH recommends that occupational exposure to asbestos be eliminated or, if it cannot, the exposure must be controlled to the lowest level possible.[11] This recommendation is based on the proven human carcinogenicity of asbestos and on the absence of a known safe threshold concentration. From the evidence presented, NIOSH has concluded that asbestos is a carcinogen capable of causing, independent of smoking, lung cancer and mesothelioma. It is NIOSH's contention that there is no safe concentration of exposure to asbestos. Virtually all asbestos exposure studies to date have demonstrated an excess of asbestos related disease. NIOSH investigators, therefore, evaluate workplaces under the premise that there should be no detectable levels of asbestos. In the absence of other information, the finding of a detectable level of asbestos indicates a need for further evaluation of the work environment or the implementation of recommendations to reduce exposures.

The Federal Occupational Safety and Health Administration (OSHA) standard for asbestos limits exposure to 0.2 fiber/cc (>5 um in length) averaged over an 8-hour workday.[12] OSHA has also established an asbestos excursion limit for the construction industry that limits worker exposures to 1.0 fiber/cc averaged over a 30-minute exposure period.[13] There is also a provision for the medical monitoring of workers routinely exposed to levels in excess of 0.1 fibers/cc. This exposure standard was devised to minimize the risk of developing asbestosis.

VI. Results

A. Air Samples Analyzed by Phase Contrast Microscopy

The analytical results of the air samples collected during the NIOSH survey are presented in Tables 1 & 2. Table 1 presents the PCM analytical results for the 8 personal breathing-zone and 3 stationary area air samples. Subjective comments received from the microscopist about the fibers are also included in Table 1.

The air samples were collected on several floors of the building (outside the containment area) in areas where normal work activities were occurring. All of the PCM results showed fiber concentrations to be above the analytical LOD of 0.003 f/cc (outdoor sample taken at Albright). Personal exposures ranged from 0.006 fibers/cc to 0.037 fibers/cc. Area sample fiber counts ranged from 0.011 to 0.103 fibers/cc (excluding the outside sample). Overloading of filters is a limiting factor in distinguishing single fibers, however, none of the NIOSH PCM samples collected at the power station during this survey were overloaded.

B. Air Samples Analyzed by Transmission Electron Microscopy

Four of the air samples analyzed by PCM were subsequently analyzed by TEM. These results are presented in Table 2. Asbestos fibers were detected on all four air samples. The microscopist performing the TEM analysis reported that 9% to 75% of the fibers detected were chrysotile asbestos. Therefore, since "A" counting rules were used both with the PCM and TEM analyses, 9% to 75% of the fibers counted by PCM can be considered as asbestos fibers.

C. Bulk Material Samples

The percentage of asbestos estimated to be in the four bulk samples of insulated wire (thermocouple cables) analyzed by an independent laboratory, at the request of the Chapman Corporation, ranged from 5 to 80%.

Bulk samples collected in August 1989, (long after the asbestos containment/enclosure had been removed), by Power Station officials, from various work areas around boiler #3, and analyzed by PLM for asbestos, contained concentrations of chrysotile asbestos ranging from 2 to 23%. Several bulk dust samples, and settled dust air samples (vacuum-type samples), collected by a worker representative, from areas surrounding boiler #3, outside the containment area, were also analyzed by PLM. Chrysotile asbestos area concentrations were reported to range from non-detectable to 85% in these samples.

VII. Discussion and Conclusions

This evaluation of particular areas in the power plant showed that there was an increased potential risk for exposure to asbestos-containing dusts. Sampling and analysis showed that fiber releases outside the containment area have occurred. The concentrations measured were above the range of fiber concentrations normally reported in ambient air in U.S. cities (0.0003 to 0.003 fibers/cc), and above the concentration of asbestos fibers found outside the plant (next to one of the job assignment trailers; 0.003 fibers/cc).

Four of the electrical employees who wore the NIOSH sampling pumps, worked with cables/wires which were coated with asbestos. None of these electrical workers were seen wearing respiratory protection during the NIOSH survey. What contribution the rewiring work had in the amount of fibers detected in the air, as compared to asbestos fibers linked to the asbestos abatement removal activity, could not be ascertained. The analytical results of the bulk samples (settled dust, wipe, and short-term vacuum-type air samples) collected independently by power station officials, and by a worker representative, are included in this report for information purposes only. These samples were not collected by NIOSH personnel.

Two separate but independent NIOSH investigations were conducted at the power station while the asbestos containment/enclosure was still in place. During these two surveys, the following observations were made: a) breaches of the asbestos containment area (rips/tears and holes in the plastic walls) were noted, b) some areas of the containment enclosure were under positive pressure relative to outside the containment area, as evidenced by some of the plastic containment walls bulging outward, c) one worker was seen leaving the containment area without either showering and/or changing outer protective garments and, d) several negative pressure air units were observed with pressure drop indicator lights illuminated. These lights warn that filters are overloaded and that filtration efficiency has decreased. This may have resulted in asbestos fibers exhausting from the containment area.

Because the onset of asbestos-associated cancers generally follows initial exposures after long latency periods of 20 to 30 years or more, the early recognition, evaluation, and control of potentially hazardous exposures to asbestos are essential. Any maintenance, repair, or removal of this material without adhering to strict control measures will likely result in a hazardous exposure.

VIII. Recommendations

If asbestos containing materials are removed in large quantities hazardous exposures will likely result if 1) proper removal techniques, 2) exposure controls, and 3) proper disposal methods are not used. Considerable attention has been paid to these three subject areas in asbestos abatement over the last decade in the United States. The use of this technology at the Albright Power Station should not be difficult. A fourth area, which may require more effort, is education and training. The ability to identify potential asbestos-containing material, to understand the health hazards associated with exposure to asbestos, and to undertake appropriate control techniques are equally important.

We recommended that all asbestos abatement contractors have a comprehensive and effective occupational health program addressing potential exposures to asbestos. As part of this program, the contractor should have sufficient staff with working knowledge, expertise, and guidance as to 1) the training, technical consultation, and standardized methods necessary to conduct valid and reliable environmental sampling and analysis of asbestos, 2) the limitations (sensitivity, specificity, limits of detection and quantification) of available asbestos sampling methods, 3) the assessment of risk identified by sampling and analytical programs, 4) what to tell occupationally exposed workers about their level of risk of asbestos-associated diseases, 5) how to decide whether to implement a control program, and 6) how to choose between alternative control measures.

Additionally, the following recommendations are made to assist in reducing asbestos exposures at the Albright Power Station:

1. A group headed by the power plant management and with representatives from the asbestos abatement contractor, other contractors on site, and labor representatives, should be formed

to coordinate and administer the policies on asbestos at the Albright Power Station. Those making up this group should receive comprehensive training in the recognition, evaluation, and control of asbestos exposures. This training should include course work in the health hazards associated with asbestos, hazard evaluation and control techniques, and the recognition of potential asbestos containing materials. In addition, course work and practical experience will be necessary in the subject areas of visual assessment, inspection of asbestos abatement job sites, modern abatement techniques, and the monitoring of abatement sites during and following abatement activities.

2. One person should be given the clear authority to administer the asbestos program for the power plant. There seems to have been a lack of enforcement of some asbestos policies and procedures, because several people have authority over different parts of the program or because the program adminstrator was not given enough support. This may have resulted in a fragmented approach to the problem. The program administrator should oversee the necessary training for employees, perform inspections, oversee sample collection and ensure sample integrity, interpret results and compile periodic updates and reports, evaluate clean-up procedures including HEPA vacuum cleaner and negative pressure air unit maintenance, oversee the personal protective equipment and monitor its use, keep necessary records, perform other pertinent duties, and periodically evaluate and modify the program as necessary. It is important that the sampling data be interpretable for future reference after completion of the abatement job. Records should be kept on respirator fit tests, employee exposure and medical exam records, and other pertinent documentation.

3. The asbestos abatement program coordinator should develop guidelines and procedures to be followed by the abatement contractor or others planning asbestos abatement activities at the power plant (or work performed in the near vicinity of the abatement/containment area), regarding notification that such abatement work is planned and when it will commence. The U.S. Environmental Protection Agency (USEPA) requires notification if 260 square feet or more of asbestos containing material (materials containing >1% asbestos) are to be removed and disposed of. The USEPA also requires notification if 160 linear feet of ACM, such as pipe lagging, is to be removed and disposed of. This notification is required 20 days in advance of the project. The USEPA can then approve or disapprove the notification. Additionally, guidelines and procedures regarding a final inspection, for clearance purposes, by the abatement coordinator, following an abatement activity, should be developed. An accepted rule followed in the U.S. as a clearance criteria is an airborne fiber concentration, under <u>aggressive conditions</u>, of 0.01 fibers/cm^3, using phase contrast microscopy, both inside and outside of the abatement area.

4. The program coordinator and the abatement contractor should have staff members trained to perform various asbestos sampling techniques and interpret analytical results. The training should give instructions on a) how to use the equipment necessary to collect asbestos samples including sampling pumps, calibration equipment, filter media, tubing, etc. and, b) how to evaluate the data collected. NIOSH offers two short courses on this subject entitled "Sampling and Evaluating Airborne Asbestos Dust" (course #582), and Industrial Hygiene Measurements (course #550). Other government and non-government courses are available.

5. The contractor responsible for removing asbestos from the jobsite should make available to all personnel at the job site (including other contractors and their employees and the owners/operators of the plant) a comprehensive guidance document on the asbestos removal program. The document would be beneficial as an educational tool. The document should include a protocol for worker training and notification to ensure that everyone understands the asbestos removal program and their role in it. Also, this document should include general and specific information regarding: a) background information on exposure to asbestos, b) how to determine if an asbestos-containing material is present, c) establishing maintenance programs, d) asbestos exposure control procedures, e) modern abatement methods and, f) how to conduct asbestos abatement projects. The contractor should disseminate the document as widely as possible to let the workers know that asbestos-containing materials are hazardous if disturbed and maintenance activities which involve ACM require special work practices, personal protective equipment, and appropriate abatement techniques. The program should require prior medical certification of fitness for all contractor employees required to wear respirators on the job. In addition, quantitative fit-testing of negative pressure respirators should be required. If supplied-air respirators are provided, negative pressure fit tests without the air in the supply mode, and irritant smoke tests with the air in the supply mode, would be beneficial in evaluating "goodness of fit". The complete respirator policy should conform in all respects to the OSHA requirements as specified in 29 CFR 1910.134. The document should include a telephone number for people to call when urgent information is needed, or to report a hazardous situation.

6. All damaged, friable asbestos-containing materials which are accessible in the work areas around boiler #3 at the power plant should be identified. Precautions should be taken to prevent worker exposure to asbestos whenever asbestos containing materials are removed or modified. At the minimum, these precautions should include the use of impermeable disposable coveralls (e.g. Tyvek®), respiratory protection, disposable gloves, wet work methods, proper disposable of asbestos-containing wastes, and area isolation procedures (enclosures). Wet cleanup methods should be used in the areas

surrounding the abatement area such as mopping floors and wiping horizontal surfaces with a damp cloth. Mops and cloths should be rinsed frequently. HEPA ventilation systems should be used in work areas. Regular and preventive maintenance schedules should be instituted and monitored.

7. Use the concept of lowest feasible level of asbestos exposure to direct clearance policy. This is consistent with NIOSH's policy regarding the carcinogenicity of asbestos and the lack of a known safe level of exposure. Prior NIOSH HHE studies have recommended using 0.01 fibers/cc as an action level. This value is between the LOD and LOQ of the 7400 method using a 1000 liter sample and, therefore, would provide an acceptable statistical reliability (± 25% at the 0.01 fiber/cc level). The airborne concentration of 0.01 fibers/cc should be primarily used to direct control strategies, not determine relative health risk. In addition, this action level can be used for clearance purposes in areas after abatement or renovation activity is completed.

8. The above mentioned action level of 0.01 fibers/cc (>5um in length) should be established by collecting air samples using <u>aggressive</u> <u>sampling techniques</u>. The basic sampling protocol for aggressive air monitoring is as follows:

   a. Use a leaf blower inside the asbestos contaminated area and force air against all surfaces to stir up any asbestos fibers that may have settled out and were not detected by the visual inspection. A large fan (twenty-inch minimum) should then be placed in the center of the room to keep any asbestos fibers airborne during the air monitoring period. It is recommended that one fan be utilized for every 10,000 cubic feet of space. The fan should be directed upwards and operated at a relatively slow speed (lowest fan setting). A number of sampling sites should be selected around boiler #3 on different floors. In addition, placement of the sampling filter should approximate the workers' breathing zone height. The sampling sites, once selected, should consistently be used for routine sampling to increase the statistical reliability and reproducibility of the data. The sampling results using aggressive techniques should be below the 0.01 fibers/cc value using PCM analysis. If any samples indicate an exposure above 0.01 fibers/cc, then further action should be initiated to define the cause and direct the subsequent control action. These samples should be collected by the contractor conducting the asbestos removal. The quality and integrity of the samples collected by the contractor should be ensured by providing additional training in the technical aspects of sample collection. Pump calibrations should be maintained within ± 5% of the desired flow rate. All filters should be used "open-face" and oriented in a manner to prevent the collection of settling dust. The sampling equipment should be checked routinely during sampling to prevent sample loss due to malfunction or tampering. In addition, all technical aspects of the NIOSH 7400 method should be followed. Sampling is just as important as analysis in the evaluation of airborne asbestos exposures.

9. All future PCM counting should conform to NIOSH method 7400 using the "A" counting rules. An analytical heirarchy for the air samples collected should be established. All of the clearance air samples should first be counted using NIOSH method 7400 and aggressive sampling techniques. All air samples showing fiber concentrations in excess of 0.01 fibers/cc should be analyzed for fiber identification using EM (either TEM or SEM). TEM is often the method for asbestos analysis, however, for lower cost and faster turn-around (in the case of an abatement job, for example), SEM is adequate. TEM analysis should include EDXA and SAED components for positive fiber identification. SEM analysis should include EDXA for tentative fiber identification. A direct-transfer technique for air samples, such as the EPA or NIOSH methods is preferred for TEM preparation. If the additional analysis (EM) shows asbestos fiber concentrations to be above 0.01 fibers >5um in length, then the cause should be investigated so that corrective action can be taken.

   A certain percentage of the routine air samples that are below 0.01 fibers/cc should also be routinely analyzed by TEM. A reasonable number would be 5 percent. This analysis will provide some additional data: small asbestos fibers can be evaluated if present; samples can conclusively be determined to be non-detectable for asbestos; and other interfering fibers can be identified and reported. The samples for this analysis should be selected randomly to prevent bias. After a time, the percentage of samples analyzed by TEM can be adjusted as necessary. For example, this percentage could be lowered if all TEM analysis results in non-detectable levels.

10. Specialized environmental sampling can also be incorporated into an overall approach to address specific questions or concerns. Wipe sampling can be used to evaluate surface contamination so efficacy of cleaning techniques can be evaluated. Settled dust sampling can be used to evaluate short or long-term fallout of asbestos under normal and worst-case situations.

11. In addition to the previous specific recommendations, all policies and procedures should meet the OSHA asbestos regulations as specified in 29 Code of Federal Regulations (CFR), Section 1910.1001 (General Industry Safety and Health Standards) and 29 CFR 1926.58 (Construction Standards for Asbestos).[12,13]

12. Samples that have been analyzed by an accredited laboratory are the most defensible in terms of unquestioned analytical accuracy. If TEM is used, the analysis should be performed by

laboratories that prove good compliance with the National Institute of Standards and Technology (NIST). Appendix #II, attached to this report, describes various laboratory asbestos analysis accreditation programs.

IX. References

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11. NIOSH [1984]. NIOSH testimony to the U.S. Department of Labor: statement of the National Institute for Occupational Safety and Health, at the hearing on occupational exposure to asbestos. June 21, 1984. NIOSH policy statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health.

12. 29 CFR 1910.1001 [1986]. Code of federal regulations. Washington, DC: U.S. Government Printing Office of the Federal Register.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluations and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Electrical Workers Union, Local 425, Fairmount, WV.
2. Boilermakers, Local 667, Charleston, West Virginia.

3. Plumbers & Pipefitters Union, Local 152, Morgantown, West Virginia
4. Chapman Corporation, Washington, Pa.
5. Chempower Incorporated, Akron, Ohio.
6. Albright Power Station, Albright West Virginia
7. Combustion Engineering, Albright Power Station, Albright, WV.
8. Power Piping Company, Albright Power Station, Albright, WV.
9. OSHA Region III.
10. NIOSH Cincinnati Region.

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1

RESULTS OF PCM ANALYSIS

CHAPMAN CORPORATION
ALBRIGHT POWER STATION
ALBRIGHT, WEST VIRGINIA
HETA 89-262
JUNE 6, 1989

Location	Sample Time	Sample Volume (liters)	Concentration (fibers/cc)	Subjective Observations
Personal B.Z. Sample Wireman Pulling Cable 1st & 2nd Floors	07:16 A.M. to 03:00 P.M.	838	0.037	asbestos fibers observed
Personal B.Z. Sample Wireman 1st Flr. Turbine Area	07:12 A.M. to 03:00 P.M.	936	0.006	
Personal B.Z. Sample Wireman Pulling Cables 1st & 2nd Flr.	07:15 A.M. to 03:00 P.M.	930	0.022	
Personal B.Z. Sample 3rd Flr. Pipefitter	07:18 A.M. to 03:00 P.M.	924	0.006	
Area Sample 2nd Flr. Outside Entrance to the Containment Area	07:56 A.M. to 03:24 P.M.	896	0.011	
Personal B.Z. Sample 3rd Flr. Pipefitter	07:19 A.M. to 03:00 P.M.	922	0.011	
Personal B.Z. Sample Spreading Room Wireman	07:14 A.M. to 03:00 P.M.	932	0.011	asbestos fibers observed

continued

Table 1 (continued)

RESULTS OF PCM ANALYSIS

CHAPMAN CORPORATION
ALBRIGHT POWER STATION
ALBRIGHT, WEST VIRGINIA
HETA 89-262
JUNE 6, 1989

Location	Sample Time	Sample Volume (liters)	Concentration (fibers/cc)	Subjective Observations
Personal *B.Z. Sample Wireman 1st Floor Turbine Area	07:11 A.M. to 03:00 P.M.	938	0.009	
Personal B.Z. Sample Journey Wireman Spreading Room	07:10 A.M. to 03:00 P.M.	940	0.036	asbestos fibers observed
Area Sample 1st Flr. Outside Containment Area at Exhaust of Negative Air Unit	07:46 A.M. to 03:24 P.M.	916	0.103	
Area Sample Outside Job Assignment Trailer 200 Ft. From Plant	08:00 A.M. to 03:24 P.M.	888	<LOD	

Evaluation Criteria TWA for up to a ten-hour workshift 0.10
*Personal Breathing Zone

1. All concentrations are time-weighted averages for the period sampled.
2. These samples were collected during electrical contract work conducted outside the asbestos containment area. All samples were analyzed by PCM according to NIOSH Method 7400. All structures that qualified as fibers by the "A" counting rules were reported as fibers/mm^2 and were converted to fibers/cc. The analytical limit of detection (LOD) was determined to be 7 fibers/mm^2 or 3000 fibers/filter for 25 mm diameter filters. Using a sample volume of 925 liters, the LOD is equal to 0.003 fibers/cc.

Table 2

RESULTS OF TEM ANALYSIS

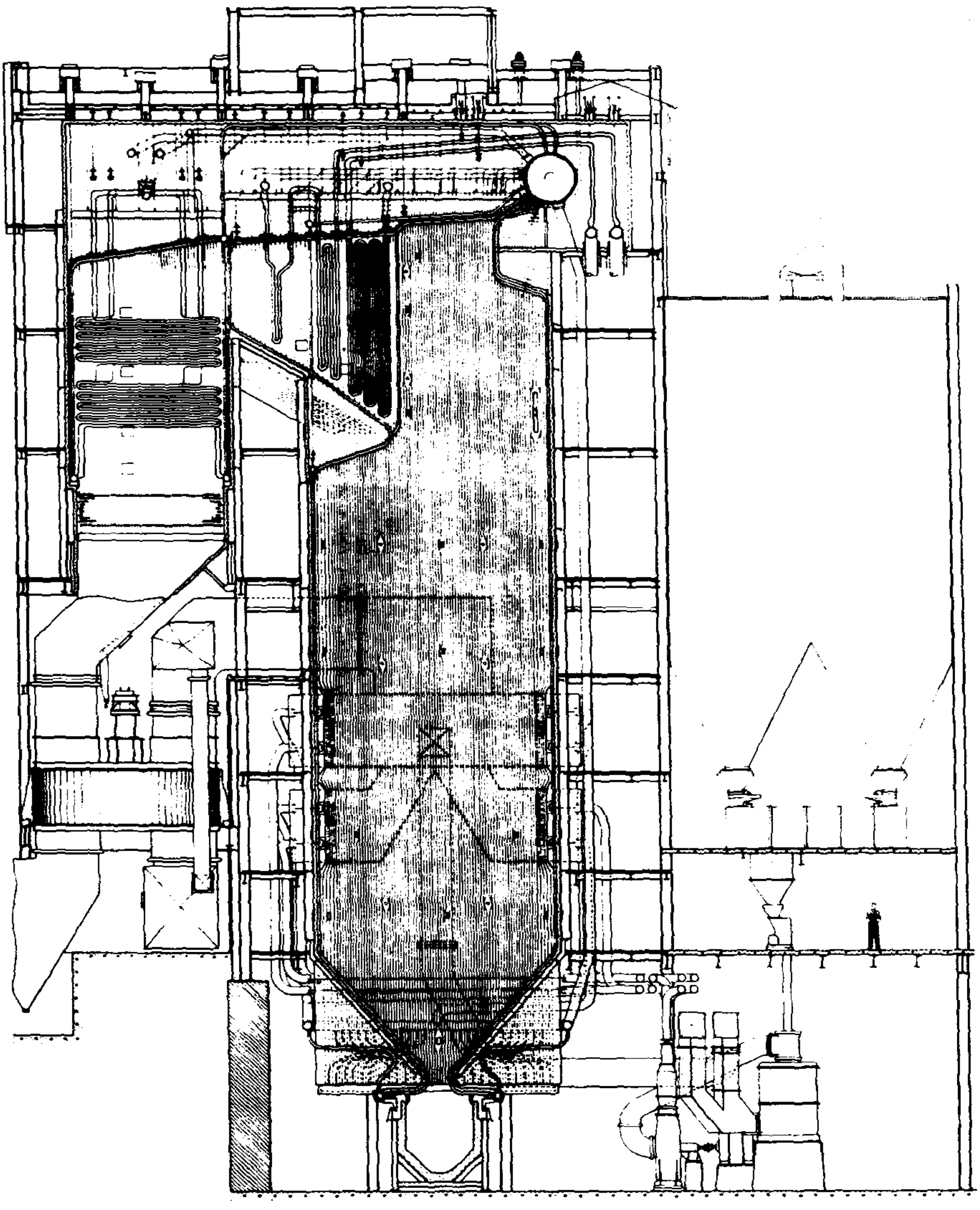
CHAPMAN CORPORATION
ALBRIGHT POWER STATION
ALBRIGHT, WEST VIRGINIA
HETA 89-262
JUNE 6, 1989

Location	Sample Time	Sample Volume (liters)	% Chrysotile Asbestos
Personal *B.Z. Sample Spreading Room	07:10 A.M. to 03:00 P.M.	940	75
Personal B.Z. Sample Pulling Cables 1st & 2nd Flr.	07:15 A.M. to 03:00 P.M.	930	9
Personal B.Z. Sample Pulling Cables 1st & 2nd Flr.	07:16 A.M. to 03:00 P.M.	838	64
Area Sample 1st Flr. Next to Exhaust Outlet of Negative Air Unit	07:46 A.M. to 03:24 P.M.	916	52

*Personal Breathing Zone

1. These samples were collected during electrical contract work conducted outside the asbestos containment area. All samples were analyzed by TEM according to NIOSH Method 7402. All structures that qualified as fibers by the "A" counting rules were reported as fibers/mm^2 and were converted to fibers/cc. The field blank revealed 6.3 fibers/mm^2.

Appendix I



C-E REHEAT STEAM GENERATOR

CAPACITY—1,000,000 LB PER HR AT 1550 PSI AND 1000 F INITIAL TEMP. REHEAT TO 1000 F.

ALBRIGHT STATION

Monongahela Power Company, Albright, W. Va.

Designed and Built by COMBUSTION ENGINEERING, INC.

SANDERSON & PORTER, Consulting Engineers

APPENDIX II

Quality Audit Programs for Laboratories Performing Asbestos Analyses

A. Quality Audit Programs for Fiber Counting by Optical Microscopy The American Industrial Hygiene Association operates three programs in this area. In order of increasing difficulty and merit, they are as follows.

1. Proficiency Analytical Testing (PAT) Program The PAT program rates each participating laboratory on the fiber-count results reported each quarter for 4 audit samples. The samples are filters containing different loadings of either chrysotile or amosite asbestos. Oversimplifying, the rating is "proficient" if three-fourths of the results are within the PAT performance limits. PAT is the oldest program providing asbestos audit samples and has over 1200 participating laboratories, which is why many contracts and regulations require PAT participation. PAT also rates laboratories for organic solvents, metals, and silica; it was established to serve the full-service industrial hygiene laboratory.

2. Asbestos Analysts Registry (AAR) Program The AAR is a quality audit program for individual asbestos counters that requires documentation of equipment, training, and procedures, and rates performance on quality audit samples quarterly. It differs from PAT in that PAT rates an entire laboratory based on one set of results, and PAT does not require documentation on training, procedures, and equipment. Although the AAR lists individual counters, applications are submitted by the counter's organization. AAR does not provide a bulk sample. AAR is intended primarily to serve the quality needs of counters monitoring worker exposure at tear-out sites.

3. AIHA Laboratory Accreditation Laboratories accredited by AIHA must participate successfully in PAT, but must meet other requirements as well. Personnel, equipment, facilities, analytical procedures, and quality control procedures must meet certain criteria and are checked by a site visitor. An accredited laboratory is said to be accredited for asbestos if it participates in the PAT program for asbestos and meets the several additional AAR requirements not already included in the accreditation procedure. These include documentation of counter training, listing of laboratories in their interlaboratory exchange group, and, if the laboratory offers on-site counting, copies of on-site counting procedures. Thus, except that audit sample counting by individuals is not required, AIHA accreditation has the most stringent requirements of all these programs. Most of the 800 laboratories in the PAT program that analyze only asbestos would find it difficult to meet the AIHA accreditation criteria.

B. Quality Audit Programs for Asbestos Identification by PLM

1. AIHA Bulk Asbestos Program The American Industrial Hygiene Association has recently begun offering a bulk asbestos qualilty assurance program. The program is similar to the EPA program which was managed by the Research Triangle Institute (RTI). It will be administered by RTI under the overall direction of AIHA. The bulk samples are intended to provide laboratories with an interlaboratory performance evaluation program. It is not a certification or accreditation program and site visits will not be performed. The interpretation of the data is entirely at the discretion of individual states or governmental agencies. No specific personnel, facility, instrumentation, or method requirements will be specified by AIHA or RTI. The program is intended for those laboratories that want an audit program for asbestos identification, but are not required by the Asbestos Hazard Emergency Response Act (AHERA) to pay the high cost of the NVLAP program.

2. NVLAP Bulk Asbestos Program On October 30, 1987, the U.S. Environmental Protection Agency (EPA) promulgated a final regulation (52 FR 41826) for the control of asbestos containing materials in schools. The regulation requires local education agencies (LEA) to employ polarized light microscopy laboratories that are accredited in the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology (NIST) (formerly NBS). The NVLAP program began in September 1988 and distributes bulk asbestos samples to participating laboratories quarterly. In April 1989, more than 300 laboratories received the first NVLAP accreditations for performance of analyses for asbestos content in bulk insulation and building materials. The NVLAP program was established to meet the requirements of the Asbestos Hazard Emergency Response Act (AHERA) of 1986.

C. Quality Audit Programs for Asbestos Identification by PLM

NVLAP TEM program After July, 1990, laboratories certifying clearance at abatement sites under AHERA are required to be accredited in the NVLAP TEM program. This progam officially started in September 1989, but site visits for the program will not begin until January, 1990.